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Prevalence, Economic and Public Health Significance of Camel Hydatidosis in Dire Dawa Municipal Abattoir, Eastern Ethiopia

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Abstract: The cross sectional study was conducted from October, 2013 to April, 2014 at Dire Dawa municipal abattoir with the objectives of determining the prevalence of camel hydatidosis and to estimate the economic loss attributed to hydatid disease. Of the 450 examined animals 129 (28.67%) were found to harbour hydatid cysts. Age, sex, body condition and origin of the animals were found statistically insignificant in variation. The total number of organs affected by one or more hydatid cyst(s) was found to be 162 out of which liver account for 83(51.23%), lung 73(45.06%), gastro intestinal tract 4(2.46%), kidney 1(0.6%) and heart 1 (0.6%). Liver infection was greater than in lung, followed by gastro intestinal tract, kidney and heart. Out of the examined cysts, 41.01% were found to be fertile and viable, while 17.94%%, 21.15% and 19.97% were non-viable, sterile and calcified cysts, respectively. The fertility of the cysts was 68.75% and 70.5% in liver and lungs, respectively.The annual financial loss at Dire Dawa municipal abattoir was estimated Ethiopian birr 27, 242.67. From the result obtained in this study, it can be concluded that hydatidosis is one of the most economically important camel disease in the area warranting serious attention. Therefore, appropriate control and prevention measures need to be taken in order to minimize the economic loss associated with the problem and to prevent the zoonotic risk to the public health.

Key words: Abattoir · Camel · Dire Dawa · Economic Significance · Hydatidosis · Prevalence

INTRODUCTION

The world human population is growing at a rate much faster than food production and this increase is mainly in developing countries, which are unable to assure adequate food for their people. Developing countries have nearly two third of the world's livestock population but produce less than a third of the world meat and a fifth of its milk [1]. However, the contribution from these huge livestock resources to the national income is small, owing to several factors draught or malnutrition, management problems, poor genetic performance and prevalent livestock diseases [2].

According to FAO statistics there are about 19 million camels in the world, of which 15 million are found in Africa and 4 million in Asia. Of this estimated world camel population, 17 million are believed to be one humped dromedary camels (*Camelus dromedarius*) and 2 million two humped camels (*Camelus bactrianus*). Approximately 11 million dromedaries, representing two thirds of the world's camel population are in the arid areas of Africa, particularly in North East Africa, i.e. Somalia, Sudan, Ethiopia and Kenya where Ethiopia possess 2.3 million of *Camelus dromedaries* mainly distributed in the southern, Eastern and Northeast pastoral regions [3]. And Ethiopia has also with an estimated 49.3 million heads of cattle, 46.9 million sheep and goats and 7.55 million equines [4].

Ethiopia has diversified topographic conditions with altitudes ranging from extremes of 4500 m above sea level in the Semen Mountains to areas 100 m below sea level in the Danakil depression. Within this diversity, climatic conditions vary from arid, tropical, sub-tropical and temperate. Given its diversified topographic and climatic

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conditions, the huge livestock population size, the different species of animals, which have evolved over time and adapted to the ecological conditions of their habitat, Ethiopia can be considered a center of diversity for animal genetic resources. Ethiopia has Africa's largest livestock population. Over 60% of its land area is semi-arid lowland dominated by a livestock economy [5].

Even though these camel animals play a crucial role in providing draught power determining the wealth, social and food status of pastoralist living in mid altitude and low land of Ethiopia, Africa and Asia little is known about their husbandry practices, productive and reproductive performances [6].

Among the prevalent livestock diseases, parasitism represents a major constraint to the development of livestock productivity in the country. Among parasitic diseases affecting camels, hydatidosis is a disease with substantial economic and public health importance occurring in many countries [7] and is becoming more endemic in many African countries [8].

Hydatidosis has a worldwide geographical distribution and occurs in all continents [9]. The distribution of *Echinococcus granulosus* is higher in developing countries especially in rural communities where there is close contact between the dog, the definitive host and various domestic animals, which may act as intermediate hosts [10]. Hydatid disease is a problem in Asia, Mediterranean, South America and Africa and also the prevalence of the disease has increased in Europe and North America in recent years [11]. In Africa *Echinococcus granulosus* has been recorded from most countries [12]. In Ethiopia, hydatidosis is the major cause of organ condemnation causing huge economic losses [13]. The epidemiology of hydatidosis various from one area to another so control measures appropriate in one area is not necessarily of valuable in another area [14].

Hydatidosis is a zoonotic parasitic infection of many mammalian species caused by the larval stage of *Echinococcus granulosus*. Adult parasitic are found in the small intestine of dog and other carnivores [15]. The infective eggs containing the onconsphere passed in feces are accidentally ingested by camel, sheep, pigs, cattle and other animals or human which act as intermediate hosts, the onconsphere in the eggs penetrate the intestine and reach the liver, lung and other organs including brain and muscles to develop in to hydatid cysts. The life cycle is completed when fertile hydatid cyst is eaten by a definitive host [16]. The adult tape worm is comparatively harmless to the dog, although in large number enteritis may be seen and the pathogenicity of hydatid cyst depends on the severity of infection and organ in which it is situated and rapture of cyst may also cause total anaphylactic shock [17].

In Ethiopia, hydatidosis is one of the major parasitic zoonotic diseases especially where camel, sheep, goat, cattle and pigs are still slaughtered traditionally and offal's are easily accessible to scavenging dog and other wild carnivores. Factor like absence of proper meat inspection procedure, poor management of food animals, traditional practices of back yard farming system, lack of awareness about food borne disease and presence of large stray dog population are though out to contribute significantly to the prevalence of the disease in Ethiopia [18].

Cystic echinococcosis, though one of the most important helminthes infection in man, has proved difficult to establish an accurate prevalence status in intermediate hosts in any content. This is partly due to poor reliability of the available diagnostic tests and high costs of performing these tests under field conditions. Most of the prevalence studies have relied on slaughter data [19].

Various investigations have conducted abattoir surveys to determine the prevalence and economic importance of parasitic diseases leading to condemnation of organs. Most of the surveys carried out in different abattoir of the country paid much attention to the parasitic causes of meat condemnation; mostly hydatidosis and fasciolosis as they are usually considered to be the major economic and public importance in meat inspection. From these parasitic disease that cause economic losses hydatidosis is one and the major [20]. Therefore, the objectives of this study were to determine the prevalence of hydatidosis in camel slaughtered at Dire Dawa municipal abattoir and to assess the economic and public health significance.

MATERIAL AND METHODS

Study Area: The study was conducted from October 2013 to April 2014 in Dire Dawa Administrative Council (DDAC) which is located in the eastern part of Ethiopia at about 518Kms from Addis Ababa; lying between 9°28' North to 9°49' North latitude and 41°38' and 42°19' East longitude. In the CSA[21] censes, the total livestock population and bee hives are estimated 399, 961. Of which camel population accounts 5,624.

Study Animal: Camels were taken randomly and routinely inspected for hydatidosis from the municipal abattoir. The camels slaughtered were brought from different areas like Babile, Dire Dawa, Hurso and Shinile.

Study Design and Sample Size Determination: A total of 450 were selected by simple random sampling method. The total number of camel required for the study was calculated based on the formula given by [22]. By rule of thumb where there is no information about the prevalence of the disease in an area, it is possible to take 50% prevalence. Therefore the sample size was calculated based on the following formula:

$$N=\frac{1.96^2\ (pexp)\ (1\text{-}pexp)}{d^2}$$

So the calculated sample size was 384 camels but 450 animals were included in the study, with the intention of maximizing the accuracy.

Abattoir Survey: Each week four days visit was made for ante mortem inspection and post mortem examination of slaughtered animals. All camel slaughtered on each visit day were included. A total of 900camels were slaughtered in the abattoir during the study period. During the ante mortem inspection, the age, sex, origin and body condition of each individual animal was assessed and recorded. Animal's age was categorized into young (≤5 year) and adult (>10 year). The age of the sampled animals was determined by dental eruption according to [23]. The body condition scoring for camels was carried out based on the guidelines given by [24]. The scoring was conducted by looking at the back and flank and then classified as poor (0 and 1), medium (2 and 3) and good (4 and 5).

Animal origin was also recorded as Babile, Dire Dawa, Hurso and Shinile by requesting information on origin of animals from the farmers or traders. Animals were identified based on enumerated marks on its body surface before slaughter using ink. Before conducting the postmortem examination the identification markings done in the ante mortem examination were transferred to all organs that are going to be examined by postmortem examination. Following a thorough visual inspection, palpation and systematic incision of each liver, lung, kidney and heart all hydatid cysts found in these organs were collected to conduct cyst fertility test.

Examination of Cysts and Checking the Viability of Protoscolices: The infected organs from each positive animal were collected. Of the collected hydatid cysts, individual content of the cyst was aspirated with a syringe to decrease its pressure and collected in a graduated beaker. The content was allowed to stay on incubator for 30 min at 36°C to settle the content and then about 10 ml of these sediments was poured to the test tube and centrifuged at 1000 rpm for 3 minutes to separate the contents clearly from the liquid part. The supernatant was discarded and the sediment with some fluid was left in the test tubes. Examination was done under objectives of 40X magnification for the presence/absence of protoscolex. The protoscolex which present as white dots on the germinal epithelium or broad capsule or hydatid sand within the suspension cyst was defined as fertile. Fertile cysts were subjected to viability test. A drop of sediment containing the protoscolices were placed on the microscopic glass slide and covered with cover slip and observed for amoeboid like peristaltic movements with 40X objective. For clear vision a drop of 0.1% aqueous eosin solution was added to equal volume of protoscolices in hydatid fluid on microscope slide with the principle that viable protoscolices should completely or partially exclude the dye while the dead ones take it up. Furthermore fertile cysts were characterized by their smooth inner lining usually with slightly turbid fluid in its content. Typical calcified cysts produce a gritty sound feeling upon incision [25].

Economic Loss Estimation: The economic values of the loss from organ condemnations were evaluated by considering the following parameters. These include; information on the mean retail market price of the organs (lung, liver, gastrointestinal tract, kidney and heart) at Dire Dawa town obtained from the butchers during study period and the average annual slaughter rate of camel at Dire Dawa municipal abattoir was estimated from the retrospective data of the last two years and the loss from organs condemned was calculated by using the formula described by [26] as follows:

$$LOC= (NAS \times Ph \times Plu \times Cplu) + (NAS \times Ph \times Phr \times Cphr) + (NAS \times Ph \times Pli \times Cpli) + (NAS \times Ph \times Psp \times Cpsp) + (NAS \times Ph \times Pkid \times Cpkid)$$

where: LOC- loss due to organ condemnation

NAS - Mean number of camel slaughtered annually
Ph - Prevalence of hydatidosis
Plu - Percent involvement of lung
Cplu - Current mean retail price of lung
Phr - Percent involvement of heart
Cphr - Current mean retail price of heart
Pli - Percent involvement of liver
Cpli - Current mean retail price of liver
Pgit - Percent involvement of git
Cpgit - Current mean retail price of git
Pkid - Percent involvement of kidney
Cpkid - Current mean retail price of kidney

Data Analysis: Raw data obtained was entered and stored in Microsoft Excel 2010 spreadsheet Computer program. The data were analyzed by using SPSS software windows version 17. A 95% confidence interval and 5% absolute precision was used to determine whether there was significance difference among hypothesized risk factors like sex, age, origin, body condition and organ affected. P value < 0.05 was considered as statistically significant in all cases.

RESULTS

Abattoir survey: The abattoir based camel hydatidosis survey in the intermediate host (camel) revealed that 129 (28.67%) of the total 450 camel viscera examined had hydatid cyst. Rate of infection of hydatidosis in different age groups (≤5 years and >10) was statistically insignificant (p>0.05). Out of 5 less than or equal to 5 years and 445 greater than 10 years old camel, 2 (40%) and 127 (28.53%) were infected with hydatid cyst respectively. Also the prevalence of hydatid cyst between sex of animals was observed statistically insignificant (p>0.05). Out of 378 females and 72 male camel, 115 (30.42%) and 14 (19.4%) were infected with hydatid cyst respectively. Also the prevalence of hydatid cyst between body condition of animals was observed statistically insignificant (p>0.05). Out of the 416 medium and 34 good body condition animal 118 (28.36%) and 11 (32.35%) were infected with hydatid cyst respectively (Table 1).

Analysis of the occurrence of infection with regard to origin was also made using proportions and described in Table 2. The rate of infection with place of origin had shown an insignificant difference (p>0.05). However, animals originated from Shinile had the highest prevalence (36.98%) while animals originated from Dire Dawa were recorded as the least prevalence (26.08%).

Organ Distribution of Hydatid Cyst: The postmortem examination revealed the distribution of hydatid cysts on lungs, liver, GIT, kidneys and heart. The total number and relative prevalence harbored by each infected organ were described in Table 3. Of the total 162 infected organs, the involvement of lung and liver accounted 73 (45.06%) and 83 (51.23%) respectively whereas GIT, kidney and heart

Table 1: Prevalence of hydatidosis based on age, sex and body condition.

Risk Factors	Number of examined animals	Number of positive animals	Relative prevalence	Chi-square (χ^2)	P-value
Age					
≤5 year	5	2	40	0.318	0.573
>10 year	445	127	28.53		
Sex					
Female	378	115	30.42	3.565	0.059
Male	72	14	19.44		
Body condition					
Medium	416	118	28.36		
Good	34	11	32.35	0.244	0.621
Total	450	129	28.67		

Table 2: Prevalence of hydatidosis based on origin

Risk Factors	Number of examined animals	Number of positive animals	Relative prevalence	Chi square (χ^2)	P-value
Origin					
Babile	295	80	27.1		
Dire Dawa	23	6	26.08	2.961	0.398
Hurso	59	16	27.11		
Shinile	73	27	36.98		
Total	450	129	28.67		

Table 3: Distribution of organs with hydatid cysts in infected camel

Organ	No of infected organs	Relative prevalence
Liver	83	51.23
Lung	73	45.06
GIT	4	2.47
Heart	1	0.62
Kidney	1	0.62
Total	162	100

Table 4: Distribution of hydatid cysts in organs of infected camel

Affected organ	No of infected organ	Prevalence (%)
Liver only	50	38.76
Lung only	40	31.0
GIT only	4	3.1
Heart only	1	0.78
Kidney only	1	0.78
Liver and Lung	33	25.58
Total	129	100

Table 5: Distribution of fertile (viable, nonviable), sterile and calcified hydatid cysts in liver and lungs of camels slaughtered at Dire Dawa abattoir

	Fertility		Infertility	
Organ infected	Viable	Nonviable	Sterile	Calcified
Liver	33 (21.15%)	15 (9.6%)	7 (4.49%)	18 (11.5%)
Lung	31 (-19.9	13 (8.3%)	16 (1.02%)	13 (8.3%)
Total	64 (41.01%)	28 (17.94%)	33 (21.15%)	31 (19.97%)

were 4 (2.46%), 1 (0.62%) and 1 (0.62%) respectively (Table 3). Of the total 129 infected camel, 40 (31.0%), 50 (38.75%), 4 (3.1%), 1 (0.77%), 1 (0.77%) and 33 (25.58%) were infected with only lung, liver, GIT, Heart,Kidney and lung and liver respectively Table 4. In general 96 (74.41%) were found involving only a single organ and the remaining 33 (25.58%) had multiple organ involvement.

Out of 156 cysts observed and examined for fertility and viability, 21.15% (33/156) were found to be viable whereas 9.6% (15/156) were nonviable and 7 (4.49%) were found to be sterile whereas 18(11.5%) were calcified in the liver. However in the lungs, 70.5% (19. 9) viable where as 8.3% (13/156) was nonviable and 16 (1.02%) were found to be sterile whereas 13 (8.3%) were calcified. Details of the percentage of viability and fertility of cysts in livers and lungs were indicated in Table 5.

Economic loss due to organ condemnation: A total of 83 livers, 73 lungs, 1 kidney and 1 heart were condemned due to hydatidosis with an economic loss of ETB 22,207.7, 4883.26, 86.69 and65.02 respectively. This was calculated from average market price of camel liver (birr 120), lung (birr 30), kidney (birr 40) and heart (birr 30) and the total number of organs condemned during the study period. On the other hand, annual economic loss was determined by considering annual slaughter rate ofcamel and prevalence of hydatidosis per liver, lung, kidney and heart. And it iscalculated to be ETB 27,242.67 annually.

DISCUSSION

The current study revealed that the overall prevalence of camel hydatidosis at Dire Dawa municipal abattoir was found to be 28.67%. In this study the prevalence of hydatidosis is relatively higher when compared to the previous reports in camel in Ethiopia by Ahmed [27] (18.6%) in eastern Ethiopia, Weldemeskel [28] (18.86%), Muskin *et al*. [29] (22.6%). Other reports elsewhere in the world reported relatively higher prevalence rates in camel reported in Iran Ahmadi [30] (35.25%), in Saudi Arabia Mohamed [31] (32.85%), further more prevalence's of 48%, 39.65%, 80% and 61.4% were reported from Libiya Ibrahim and Craig [32], Kuwait Abdul-Salam and Farah [33], Morocco Pandev *et al*. [34] and KenyaNjoroge *et al*. [35]respectively. On the contrary, comparatively lower prevalence of camel hydatidosis has been reported from Harar Ethiopia Woubet [36](4.5%) and from Egypt Dyab *et al*. [37]. These variations of the infection rates could be due to the variations in the temperature, environmental conditions and the nature of the pasture and the way of rising and grazing of these animals.

The prevalence may however vary from country to country or even within a country. In general terms, throughout the world, there had been different magnitude records of hydatidosis in camel with low, medium and high rates of occurrences. Generally the variation in prevalence rate among different geographical locations could be ascribed to the strain differences of *Echinococcus granulosus* that exists in different geographical locations McManus [38]. Additionally variability could be related with age factors. Other factors like different in culture, social activities and attitudes to dogs indifferent region may contribute to variation Arbabi and Hooshyr [39].

In this study there was no statistical variation in the prevalence rates between the areas where the examined animals comes from (Babile, Dire dawa, Hurso and Shinile). The reason for the absence of variation in the prevalence in those different places may be related with the presence of very similar environmental situation in all the four areas. However, other investigators found a variation in the prevalence's of camel hydatidosis for different areas having different environmental and climatic conditions Mohamed [31].

In this study, the prevalence of hydatidosis was higher in femalecamel 30.4% than male camel 19.71%. Similar findings has been reported in Ethiopia Muskin *et al*. [29], in Kuwait Abdul-Salam and Farah [33] and in Iran Ahmadi [30] and Rokni, [40]. This might be related to the practices in the management of male and female camels that males are moved too far for grazing and watering, whereas females are usually managed around homesteads at the backyard for milk purpose which commonly expose female animals to come in contact with infected dogs Parija [41]. In many camel breeding areas offal's are not consumed by the community rather given to dogs and this may increase the chance of environmental contamination whereby dogs can easily acquire the infection and then continuously discharge eggs of echinococcosis parasites. Consequently, as females remain longer than males for reproductive purposes in the area, the probability of getting more infection will be higher than male ones. Moreover, the situation becomes more exacerbated as dogs are not kept indoor for religious and traditional matters resulting in increased number of stray dog's favors further dissemination of the disease.

Among the young and adult animals 40% and 28.53% respectively were positive for hydatosis. However, other investigators found, out of 28.63% adult animals were positive and out of 19.04%young animals were positive Muskin *et al*.[29].

Out of the 416 medium body condition animals 28.36% werepositive and out of the 34 good body condition animals32.35% were positive, this finding is in agreement with the work of Bulto *et al*. [41] where out of 712 medium body condition animal 434 were positive 434 (60.9%) and out of the 58 good body condition animal 40 were positive 40 (68.9%) and Bayleyegn *et al*. [43]. However, in another work higher prevalence rate was found in medium body condition animals than good body condition animal, out of 133 medium body condition animals 23.3% were positive and out of 88 good body condition animals 23.3% were positive Dawit *et al*. [44].

It has been established that hydatid cyst occur predominantly in lungs and liver. Immature parasites have no selective affinity for any particular organ and location of hydatid cyst in animal is controlled by filtering action of capillaries. This could be due to the fact that lungs and liver possesses the first great capillaries sites encountered by the migrating *Echinococcus* onchosphere (hexacanth embryo) which adopt the portal vein route and primarily negotiate hepatic and pulmonary filtering system sequentially before any other peripheral organ is involved, but onchospheres which traverse thesewill reach the systemic circulation and hydatidshave been found in many organs and tissues Getaw *et al*. [45]. The study revealed that hydatid cysts occur predominantly in the lung and liver and occasionally in GIT, kidney and heart. From the total of 162 infected viscera about 156 (96.29%) were due to overall involvement of lung and liver. This finding is in agreement with the work of Kebede *et al*. [46]. The fact that hydatid cysts showed greater preference for lung and liver than other viscera could be ascribed to presence of the dense capillary networks in these organs which filter out and retain the oncosphere of *Echinococcus granulosus* before being encountered by peripheral organs.

The fertility rate among the organs was found slightly higher in lungs (19.9%) compared to liver which was (21.15%). It has been stated that the relatively softer consistency of lung tissue allows the easier development of the cyst Himonas [47]. This result was also in agreement with the reports of Ahmadi [30] from Iran who demonstrated that the fertility of the cyst from lungs was 69.7% as compared to 58.7% from liver in slaughtered camel in five different abattoirs. The greater prevalence and high fertility rate of pulmonary cyst over hepatic cyst of camel indicate the importance of internal organs as a potential source of infection to dogs.

The present study was emphasized to carry out any assessment on annual economic loss due to camel hydatidosis at Dire Dawa municipal abattoir. Losses from offal condemnation and estimated at ETB 27,242.67. Such loss is of particular importance in Ethiopia, which has low economic output. Other economic losses regarding camel hydatidosis were also reported from different part of the country.Bayleyegn *et al*. [43]. ETB 1,089,758.8. The difference in economic loss estimated in various abattoirs/regions may be due to variation in the prevalence of the disease, mean annual number of camel slaughtered in different abattoirs and variation in the retail market price of organs in different regions. In addition to the losses incurred in the abattoir, hydatidosis could have economic impact due to invisible losses like impaired productivity, for example, reduced traction power which results in reduced crop yield Polydrous [48].

CONCLUSION

Echinococcosis, which causes a considerable loss to livestock industry is also a serious threat to public health and is highly prevalent in camel slaughtered at Dire Dawa municipal abattoir. The abattoir doesn't have proper waste disposal system organ harboring different lesions and cysts were disposed together with GIT contents.

Such kinds of practice can enhance the continuation of the life cycle between the intermediate and the final hosts (dogs) and further may increase the risk of zoonotic infections to human beings residing in and around Dire Dawa town. Moreover, backyard slaughtering system, the presence of packs of stray dogs, the relations existing between livestock and pet animals, the limitation slaughter house, the improper disposal of waste material from abattoir the nil emphasis given to the health of pet animals are the main factors that may have contributed to the prevalence and distribution of the disease.

RECOMMENDATION

Awareness creation programs should be launched, for butchers, abattoir workers and dog owners as to the danger of hydatidosis to human as well as animal health.Immediate attention should be paid to the safely controlled elimination of all controlled abattoir materials. Destruction/decreasing stray dogs considerably all available means, spaying of bitches should be encourage. Proper health care, which and the third most important measures to be taken in reducing the parasites by mass in the area and veterinary supervision of individually owned dogs is also paramount importance. According to the result in the area, animals originated in and around Dire Dawa markets were positive for the disease. It has been the cause of considerable economic loss and damage to basic human health. Therefore, in pertinent agencies, such as public health, agricultural and educational institutions participate directly by providing appropriate administrative, legal, technical and economic support will minimize losses from the disease. The prevention of dogs against access to raw offal is an effective control measure and dog owners should be advised to feed their dogs with properly cocked offal to enable the control of hydatidosis. Enforcement of legislation that will put an end to backyard slaughtering practice by giving extensive public education.

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